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Glock et al.

[11] **3,885,893**

[45] **May 27, 1975**

[54] **MULTIPLE CYLINDER PUMP**

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[30] **Foreign Application Priority Data**

Apr. 17, 1973 Germany 2319307

[52] **U.S. Cl.** **417/273;** 137/512.1; 137/516.11

[51] **Int. Cl.** **F04b 1/04;** F16k 15/00

[58] **Field of Search** 417/273; 91/491; 137/512.1, 516.11, 516.15

[56] **References Cited**

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Attorney, Agent, or Firm—Hans Berman; Kurt Kelman

[57] **ABSTRACT**

A pump having multiple cylinders radiating from a common intake cavity, receiving respective pistons driven by a central, eccentric cam, and connected to a common outlet manifold by respective outlet conduits is provided with a check valve assembly in the manifold in which circumferentially spaced guide pins are fixedly fastened to a common connecting ring, and each pair of circumferentially adjacent pins guides a valve plate for free movement toward and away from the orifice of an associated outlet conduit.

10 Claims, 9 Drawing Figures

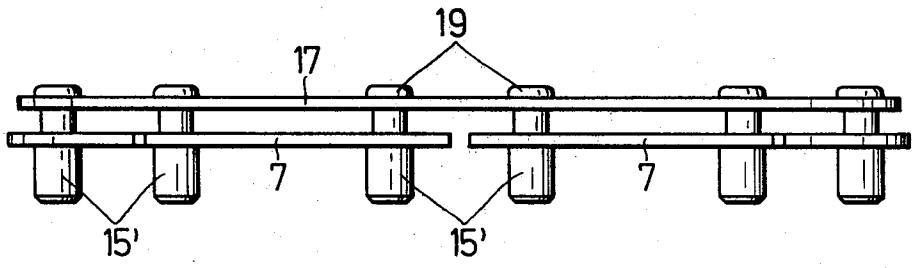
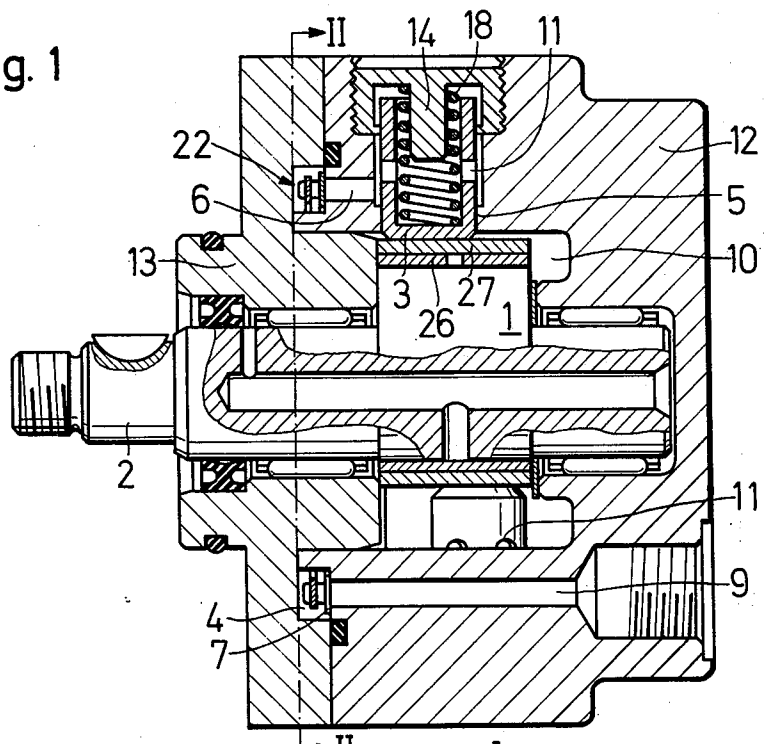


Fig. 1


II
14
18
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6
5
13
10
3
27
26
1
2
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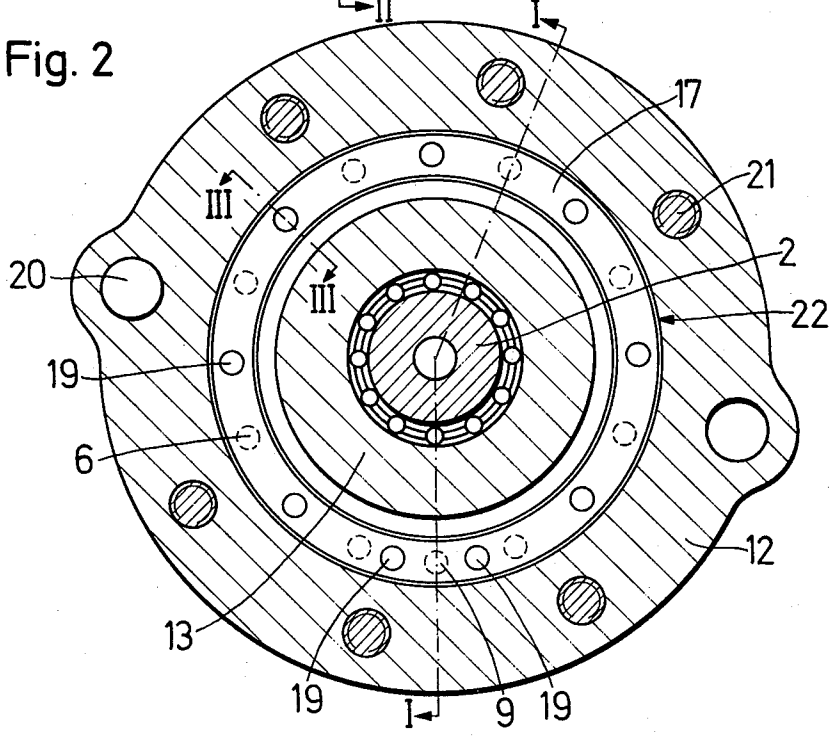
4
7
II

Fig. 2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III
21
III
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22
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12
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I
9
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Fig. 3

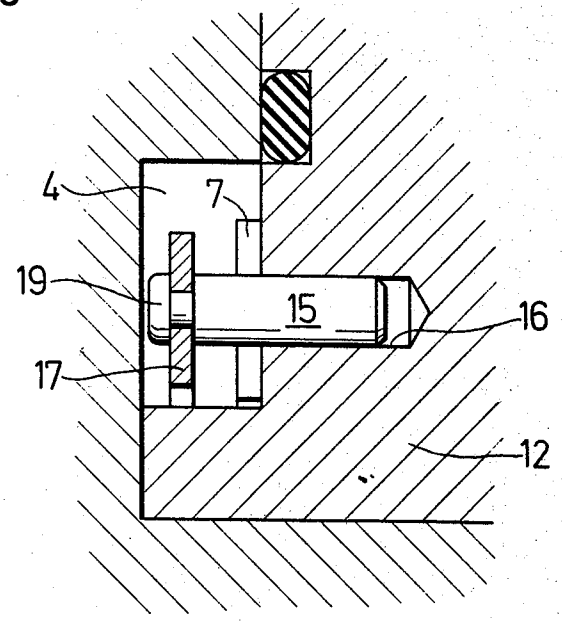


Fig. 4

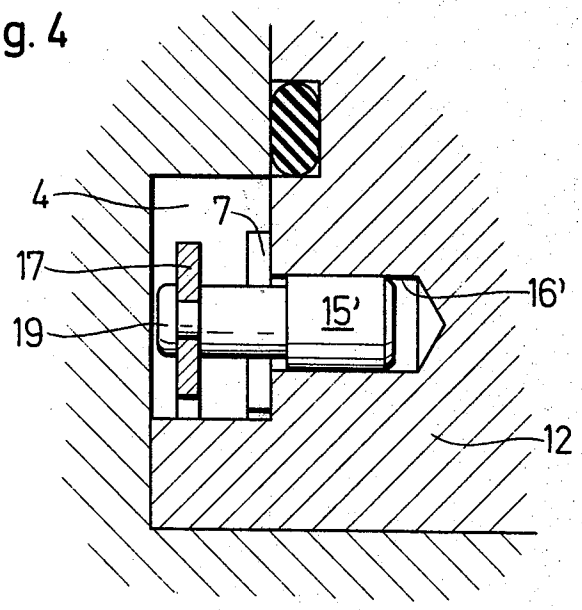


Fig. 5

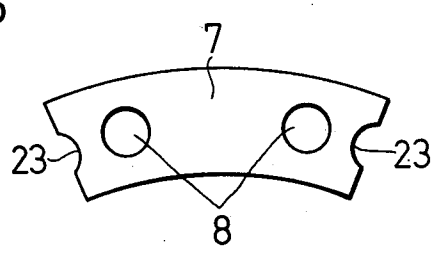


Fig. 6

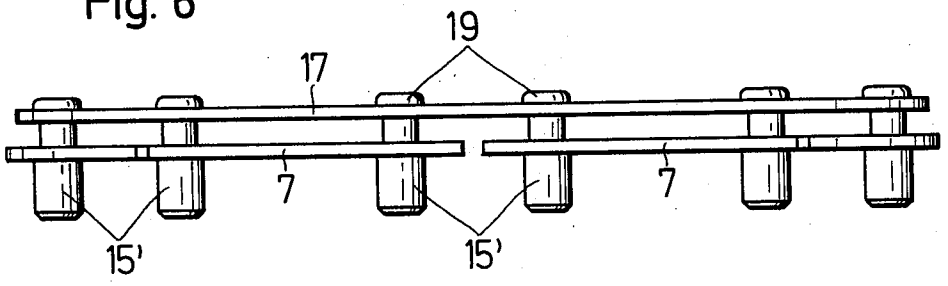


Fig. 7

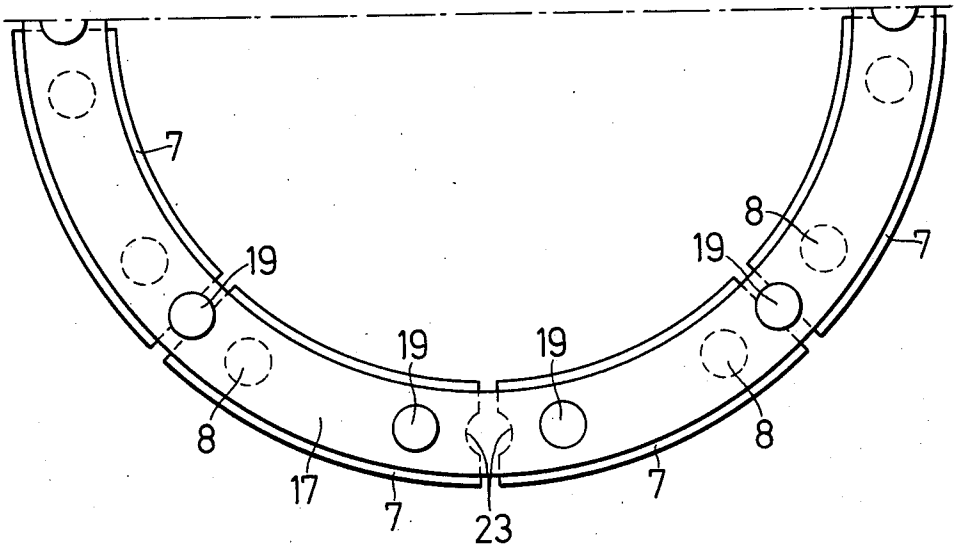


Fig. 8

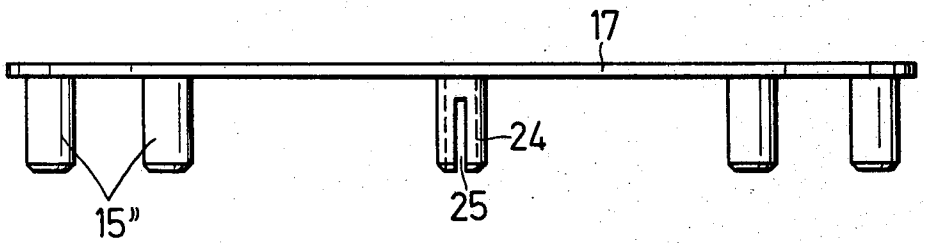
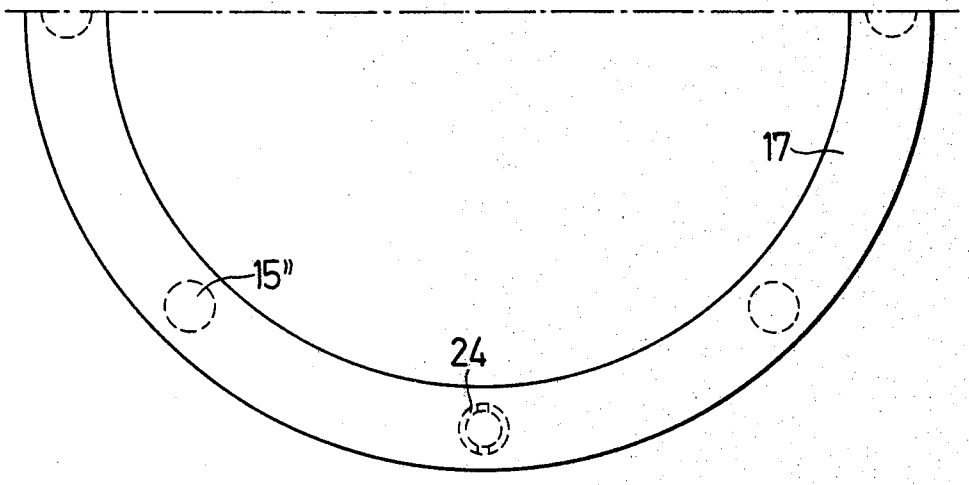


Fig. 9



MULTIPLE CYLINDER PUMP

This invention relates to multiple-cylinder pumps in which a rotating shaft actuates sequential reciprocating movement of pistons in a plurality of cylinders connected to a common intake cavity for receiving fluid and connected to a common manifold by respective outlet conduits for discharging the pumped fluid. More particularly, this invention is concerned with an improved check valve arrangement in the outlet conduits for permitting fluid flow in a direction from each cylinder toward the manifold while impeding or preventing fluid flow in the opposite direction.

The multiple cylinders of the pumps with which this invention is concerned may be packed closely to form a compact device producing a continuous stream of fluid under pressure. They rely for proper operation on their check valves, and it has been difficult heretofore to provide a pump of the type described and having a relatively large number of cylinders with check valves that are effective, yet do not occupy more space than can readily be made available without significantly increasing the overall bulk of the pump.

It is a primary object of this invention to improve pumps of the general type described by means of check valves which are simple, inexpensive to build and install, yet reliable in preventing reverse flow of fluid from the outlet manifold into the cylinders.

With these and other objects in view, as will presently become apparent, the invention provides a multiple cylinder pump with a plurality of individual first valves respectively associated with the outlet conduits of the several cylinders. Each check valve includes an elongated valve plate arranged in the common outlet manifold and guided transversely to its direction of elongation toward and away from a position of sealing engagement with the orifice of the associated outlet conduit, the orifices of the conduits being circumferentially spaced in the manifold about the axis of the drive shaft. The guide arrangement includes guide pins circumferentially spaced in the manifold, two longitudinally spaced portions of each valve plate slidably engaging respective guide pins.

Other features, additional objects, and many of the attendant advantages of this invention will readily be appreciated as the same becomes better understood from the following detailed description of preferred embodiments when considered in connection with the appended drawing in which:

FIG. 1 shows a radial piston pump according to the invention in axial section on the line I—I in FIG. 2;

FIG. 2 shows the pump of FIG. 1 in radial section on the line II—II;

FIG. 3 illustrates a portion of the same pump in enlarged section on the line III—III;

FIG. 4 shows a modification of the device of FIG. 3 in a corresponding view;

FIG. 5 shows a valve plate common to the devices of FIGS. 1 to 4 on a smaller scale;

FIG. 6 illustrates a check valve assembly of the invention including the device of FIG. 4 in a fragmentary view corresponding to that of FIG. 1, but on a larger scale;

FIG. 7 shows the assembly of FIG. 6 in a view corresponding to that of FIG. 2;

FIGS. 8 and 9 illustrate a modified check valve assembly in respective views analogous to those of FIGS. 6 and 7.

Referring now to the drawing in detail, and initially to FIGS. 1 and 2, there is seen a radial piston pump whose housing consists of a generally cup-shaped body portion 12 and a cover portion 13 attached to the body portion by bolts 21 and closing a cavity 10 in the body portion. A drive shaft 2 is journaled in antifriction bearings in the housing 12, 13 and projects axially from the housing. It carries a fixed eccentric, cylindrical cam 1 in the cavity 10. A sleeve 26 is rotatably interposed between the cylindrical face of the cam 1 and a cylindrical contact ring 27.

Eight cylinder bores 5 radiate from the cavity 10 in the body portion 12 in equiangularly spaced relationship. The bores 5 are alternatingly arranged in two axially offset planes to permit their tightly packed arrangement. Each bore 5 is sealed in a radially outward direction by a threaded plug 14 and receives a hollow piston 3. A helical compression spring 18 interposed between the plug 14 and the piston 3 holds the piston radially against the contact ring 27. The piston 3 sealingly engages a shoulder on the associated cylinder wall near the cavity 10 except in the radially innermost position of the piston when ports 11 in the piston communicate with the cavity 10.

An axial outlet conduit 6 leads out of each cylinder bore 5 into a circular manifold duct 4. A discharge conduit 9 leads outward of the housing 12, 13 from the manifold duct 4, and a similar intake conduit, not specifically illustrated, leads into the cavity 10 for supplying the fluid to be pumped which is ultimately discharged from the conduit 9. The structure described so far is largely conventional and may be mounted in a small space by means of lugs 20 on the housing 12, 13.

A pump of the type illustrated needs check valves for interrupting communication between the manifold duct 4 and each cylinder bore 5 during the suction stroke of the piston 3, and this invention particularly relates to the check valve assembly 22. As is evident from joint consideration of FIGS. 1 to 3, the orifices of the conduits 6 are spaced 45° apart in the manifold duct 4, and seven guide pins 15 are circumferentially centered between successive orifices, two additional guide pins 15 being arranged between the two conduit orifices at the bottom of FIG. 2, only the rivet heads 19 of the nine guide pins being seen in FIG. 2 above a flat, circular connecting ring 17 fixedly fastened to the pins 15 by the heads 19. The connecting ring 17 is a sheet metal stamping received in the manifold duct 4 with much clearance, as is best seen in FIG. 3. One longitudinal end portion of each pin 15 is received in a blind, axial bore 16 of the body portion 12 with a friction fit.

The pins 15 axially guide eight identical valve plates 7 of which one is seen in FIG. 5. Each valve plate is a segment, slightly shorter than 45°, of a flat, sheet metal ring. The radial width of each plate 7 is much smaller than its circumferential length, and much greater than the axial thickness of the plate 7. The two longitudinal end portions of the plate 7 are each formed with a through-bore or passage 8 between the two major plate faces, and each of the narrow, transverse end faces is formed with an approximately semicircular notch 23. As is best seen in FIG. 7, each valve plate 7 fits circumferentially between two of the seven evenly spaced guide pins 15 and slidably receives the longitudinal por-

tions of the two associated guide pins outside the bores **16** in its two notches **23.** The two valve plates **7** near the bottom of each of FIGS. **2** and **7** engage one guide pin in a notch **23** while slidably receiving another guide pin in a bore **8** so that their adjacent notches **23** bound an open gap in the annular array of valve plates **7.**

The pump described operates as follows:

During the radially inward suction stroke of each piston **3,** the associated valve plate **7** is moved quickly on the engaged guide pin **15** toward the orifice of the corresponding outlet conduit **6** by fluid drawn from the manifold **4** and seals the engaged orifice. When the ports **11** communicate with the cavity **10,** the cylinder bore **5** is filled with fluid. During the compression stroke, while the ports **11** are withdrawn into the bore **5,** the fluid is driven into the conduit **6,** lifts the plate **7,** and flows into the manifold **4.** Fluid flow is facilitated, and the opening movement of the valve plate **7** is hastened by the bores or passages **8.** The opening movement of the valve plate **7** is limited by abutment against the connector ring **17.** Fluid is released from the manifold duct **4** through the discharge conduit **9** whose orifice is located where the gap in the array of valve plates **7,** described above with reference to FIG. **7,** provides a minimum of flow resistance.

The valve assembly consisting of the connector ring **17,** the guide pins **15** riveted to the ring, and the valve plates **7** whose longitudinally terminal portions receive respective pins **15** either in the notches **23** or the bores **8,** may be installed as a unit on the body portion **12** immediately before construction of the pump is completed by fastening the cover portion **13.** The pins **15** are simultaneously forced into the bores **16** whose distribution about the circumference of the manifold duct **4** in the body portion **12** is evident from the location of the rivet heads **19** in FIG. **2** or **7.**

Installation of the check valve assembly is further facilitated if the pins **15** are replaced by the shoulder pins **15,** best seen in FIGS. **4** and **6.** These pins have enlarged longitudinal portions received in corresponding blind bores **16'** of the body portion **12** and having a circular cross section of a diameter greater than the diameters of the bores **8** and notches **23.** The valve plates **7** are placed on the shoulders of the pins **15'** between the two portions of different cross section before the ring **17** is rivetted to the pins. Thereafter, the plates **7** may move freely with minimal friction between positions of abutting engagement with the ring **17** and with the shoulders of the pins **15',** but cannot fall from the pins **15'** prior to installation. The entire wider portion of each pin **15'** is inserted in the appropriate bore **16',** as is shown in FIG. **4,** so that the operation of the modified check valve is unchanged. One half of a check valve assembly, not yet installed and having shoulder guide pins **15',** is shown in FIGS. **6** and **7.**

In the further modified check valve assembly, shown without its valve plates in FIGS. **8** and **9,** seven straight, cylindrical pins **15''** are spot-welded 45° apart to the connector ring **17** for insertion into corresponding bores **16.** The eighth position on the ring **17** is occupied by a tube **24** equal in diameter to the pins **15''** and slotted axially over much of its length to its free end remote from the ring **17.** If the check valve assembly illustrated in FIGS. **7** and **8** is provided with valve plates **7,** the pins **15''** as well as the tube **24** are received in notches **23,** the pins **15''** are inserted in bores **16** in a manner obvious from FIG. **3,** and the tube **24** is inserted into the orifice of the discharge conduit **9.** Its slot **25** provides a relatively large flow section for the pumped fluid leaving the manifold duct **4.**

While the invention has been described with specific reference to a radial cylinder pump whose pistons are reciprocated by means of an eccentric, radial cam, it is equally applicable in an obvious manner to a pump whose several cylinders are parallel to the axis of the drive shaft and angularly distributed about the shaft axis, their pistons being reciprocated by a wobble plate or an analogous axial cam on the drive shaft. The advantages of the check valve arrangement of the invention thus are not limited to the specific type of pump illustrated.

These advantages include low cost of construction and installation, simplicity and corresponding long life, very sensitive, quick response to reversal of fluid flow in the outlet conduits **6,** and independence of the several valve plates from each other. No return springs are needed. The several cylinders necessarily are out of phase, and the efficiency of each cylinder is impaired if its check valve has a movable valve member not entirely independent from the movable valve member associated with another cylinder.

It is most practical in relatively small pumps of the type illustrated to have a housing of few parts form the walls of the cavity **10,** the walls of the bores **5** which constitute cylinders, the outlet conduits **6,** and the manifold duct **4,** but these elements may be constituted by separate structural units particularly in large pumps.

It should be understood, therefore, that the foregoing disclosure relates only to preferred embodiments of the invention, and that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purpose of the disclosure which do not constitute departures from the spirit and scope of the invention set forth in the appended claims.

What is claimed is:

1. In a pump including wall means defining an intake cavity, a shaft having an axis and mounted for rotation about said axis, a plurality of cylinders communicating with said cavity and extending from the same in angularly spaced relationship relative to said axis, a piston movable in each cylinder, an outlet conduit communicating with each cylinder, actuating means on said shaft for sequentially moving said pistons in the respective cylinders during rotation of said shaft and for thereby pumping fluid from said cavity to said conduits, an annular manifold communicating with said conduits and circumferentially extending about said axis, a plurality of check valve means respectively associated with each conduit for permitting fluid flow from the associated conduit toward said manifold while impeding fluid flow from said manifold into the associated conduit, and a discharge conduit leading outward of said manifold, the improvement in each of said valve means which comprises:

a. an elongated valve plate in said manifold,
   1. said outlet conduits having circumferentially spaced respective orifices in said manifold; and
b. guide means in said manifold guiding said valve plate transversely to the direction of elongation thereof toward and away from a position of sealing engagement with the orifice of the associated conduit,
   1. said guide means including a plurality of guide pins circumferentially spaced in said manifold,

2. two longitudinally spaced portions of each valve plate slidably engaging respective ones of said guide pins.

2. In a pump as set forth in claim **1,** said guide means further including a connecting member fixedly fastened to each of a plurality of said guide pins and offset from the valve plates engaging the fixedly fastened guide pins in a direction away from the orifices of the outlet conduits associated with the engaging valve plates.

3. In a pump as set forth in claim **2,** said manifold being approximately circularly arcuate about said axis, and said connecting member being a flat ring of sheet material extending in said manifold in an arc about said axis.

4. In a pump as set forth in claim **3,** said guide means guiding said valve plates for free movement between respective positions of abutting engagement with said connecting member and said respective positions of sealing engagement, each valve plate in said position of sealing engagement only one of said orifices.

5. In a pump as set forth in claim **3,** a housing constituting said wall means, said cylinders, said outlet conduits, and said manifold, said outlet conduits extending from said orifices thereof inward of said housing in the direction of said axis, said housing being formed with axial bores open toward said manifold, said guide pins being partly received in said bores.

6. In a pump as set forth in claim **5,** each guide pin being elongated and having respective first and second longitudinal portions, the firs portion being received in said manifold and being smaller in cross sectional area than the second portion, said second portion being received in said one bore, the valve plate engaging said guide pin being formed with a recess conformingly receiving said first portion and too small to receive said second portion.

7. In a pump as set forth in claim **2,** each valve plate having an end face transverse to the direction of elongation thereof, said end face being formed with a longitudinally open notch receiving one of said guide pins.

8. In a pump as set forth in claim **7,** said one guide pin being simultaneously received in said notches of two valve plates circumferentially offset from each other, said valve plates being arranged in end-to-end relationship in circular array about said axis.

9. In a pump as set forth in claim **2,** each valve plate being formed with a passage therethrough in the direction of flow of fluid from the associated orifice, said passage being interposed circumferentially between said associated orifice and one of the guide pins engaged by said valve plate.

10. In a pump as set forth in claim **2,** one of said longitudinally spaced portions of at least one of said valve plates being formed with a bore extending therethrough in the direction of fluid flow from the associated orifice, one of said guide pins being received in said bore.

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